PROPERTIES OF LINEAR LOW DENSITY POLYETHYLENE/SILICONE RUBBER NANOCOMPOSITES FOR HIGH VOLTAGE INSULATION APPLICATION

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by

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LIST OF ABBREVIATIONS

AC	Alternating current
ANOVA	Analysis of variance
ATR	Attenuated total reflectance
BN	Boron nitride
CCD	Charge-coupled camera device
DBS	Dielectric breakdown strength
DC	Direct current
DCP	Dicumyl peroxide
DOE	Design of experiment
DSC	Differential scanning calorimetry
EB	Electron beam
EPDM	Ethylene propylene diene monomer
EPR	Ethylene propylene rubber
EVA	Ethylene vinyl acetate
FTIR	Fourier transform infrared
HRTEM	High-resolution transmission electron microscopy
HTV	High-temperature vulcanized
HV	High voltage
IEC	International Electrotechnical Commission
LDPE	Low density polyethylene
LLDPE	Linear low density polyethylene
LMW	Low molecular weight
OFAT	One factor at a time

PDMS	Polydimethylsiloxane
PE	Polyethylene
PP	Polypropylene
RSM	Resonance surface methodology
RTV	Room-temperature vulcanized
S1	Sequence 1
S2	Sequence 2
S3	Sequence 3
SEM	Scanning electron microscopy
Si	Silica
SR	Silicone rubber
TPE	Thermoplastic elastomer
UV	Ultraviolet
VMQ	Vinyl methyl quality
XLPE	Crosslinked polyethylene
ZO	Zinc oxide

LIST OF SYMBOLS

ΔH_f	Melting enthalpy
G’	Storage modulus
h	Hours
kGy	Kilogray
kV	Kilovolt
kV/mm	Kilo volt per milimiter
MeV	Megaelectron-volts
MPa	Megapascal
V_p	Peak-to-peak voltage
R^2	Correlation coefficient
V_{rms}	Root mean square voltage
tan δ	Dielectric loss tangent
T_g	Glass transition temperature
T_{pc}	Crystallization peak temperature
vol%	Volume percent
W_a	Wetting coefficient
W_{AB}	Work of adhesion
wt%	Weight percent
X_c	Percentage of crystallinity
α	Weibull scale parameter
β	Weibull shape parameter
γ	Surface tension
γ_{AB}	Interfacial tension

γ_c	Critical strain
γ^d	Dispersion component surface tension
γ^p	Polar component surface tension
ε'	Permittivity
η^*	Complex viscosity
ω	Frequency

SIFAT- SIFAT KOMPOSIT NANO POLIETILINA BERKETUMPATAN RENDAH LINEAR/GETAH SILIKON UNTUK APLIKASI PENEBAT BERVOLTAN TINGGI

ABSTRAK

Kajian ini menyiasat prestasi komposit nano termoplastik elastomer berasaskan campuran polietilena berketumpatan rendah linear (LLDPE) dan getah silikon (SR) diisi dengan pelbagai jenis pengisi nano bukan organik seperti silika (Si), boron nitrida (BN) dan zink oksida (ZO) untuk aplikasi penebat bervoltan tinggi. Bahagian pertama kajian menyiasat kesan urutan pencampuran yang berbeza pada sifat-sifat komposit nano LLDPE/SR/BN. 5 vol% nano-BN telah dimasukkan ke dalam 70/30 LLDPE/SR dengan menggunakan tiga urutan yang berbeza; LLDPE + SR + BN (dicampur dalam satu langkah pemprosesan), LLDPE + (masterbatch-SR/BN) dan SR + (masterbatch-LLDPE/BN), di mana sampel-sampel dengan masterbatch disediakan dalam dua langkah pemprosesan. Sampel dengan masterbatch-SR/BN mempamerkan struktur pengkapsulan dan menunjukkan kekuatan pecahan dielektrik yang tertinggi dan ketelusan serta kehilangan tangen yang paling rendah berbanding dengan dua urutan pencampuran yang lain yang menjana struktur penyebaran terpisah. Kemudian, dengan menggunakan urutan pencampuran yang optimum, pelbagai jenis komposit nano LLDPE/SR telah disediakan. Kesan tiga formulasi parameter seperti kandungan SR (10, 20 dan 30 wt%), jenis pengisi nano (Si, BN dan ZO) dan kandungan pengisi nano (2, 5 dan 8 vol%) terhadap sifat-sifat komposit nano LLDPE/SR telah disiasat secara statistik dengan menggunakan reka bentuk eksperimen (DOE). Berdasarkan analisis DOE, didapati bahawa komposit nano